Lecture slides for
Automated Planning: Theory and Practice

Review for the Midterm Exam

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4:54 PM March 19, 2012

The Chapters We've Covered

- Chapter 1: Introduction
- Chapter 2: Representations for Classical Planning
- Chapter 3: Complexity of Classical Planning
- Chapter 4: State-Space Planning
- Chapter 5: Plan-Space Planning
- Chapter 6: Planning-Graph Techniques
- Chapter 7: Propositional Satisfiability Techniques
- Chapter 16: Planning based on MDPs
- Chapter 17: Planning based on Model Checking

Chapter 1: Introduction and Overview

- 1.1: First Intuitions on Planning
- 1.2: Forms of planning
- 1.3: Domain-Independent Planning
- 1.4: Conceptual Model for Planning
- 1.5: Restricted Model
- 1.6: Extended Models
- 1.7: A Running Example: Dock-Worker Robots

No questions on Chapter 1

2: Representations for Classical Planning

- 2.1: Introduction
- 2.2: Set-Theoretic Representation
  - 2.2.1: Planning Domains, Problems, and Solutions
  - 2.2.2: State Reachability
  - 2.2.3: Stating a Planning Problem
  - 2.2.4: Properties of the Set-theoretic Representation
- 2.3: Classical Representation
  - 2.3.1: States
  - 2.3.2: Operators and Actions
  - 2.3.3: Plans, Problems, & Solutions

No questions on these topics:

- 2.3.4: Semantics of Classical Reps
- 2.4: Extending the Classical Rep.
  - 2.4.1: Simple Syntactical Extensions
  - 2.4.2: Conditional Planning Operators
  - 2.4.3: Quantified Expressions
  - 2.4.4: Disjunctive Preconditions
  - 2.4.5: Axiomatic Inference
  - 2.4.6: Function Symbols
  - 2.4.7: Attached Procedures
  - 2.4.8: Extended Goals

- 2.5: State-Variable Representation
  - 2.5.1: State Variables
  - 2.5.2: Operators and Actions
  - 2.5.3: Domains and Problems
  - 2.5.4: Properties
- 2.6: Comparisons

Chapter 3: Complexity of Classical Planning

- 3.1: Introduction
- 3.2: Preliminaries
- 3.3: Decidability and Undecidability Results
- 3.4: Complexity Results
  - 3.4.1: Binary Counters
  - 3.4.2: Unrestricted Classical Planning
  - 3.4.3: Other results
- 3.5: Limitations

You don't need to know the details of the complexity tables, but you should know the basic concepts, e.g.:

- What does it mean to allow or disallow function symbols, negative effects, etc.?
- What's the difference between giving the operators in the input or in advance?

Chapter 4: State-Space Planning

- 4.1: Introduction
- 4.2: Forward Search
  - 4.2.1: Formal Properties
  - 4.2.2: Deterministic Implementations
- 4.3: Backward Search
- ~~4.4: The STRIPS Algorithm~~ **No questions on this topic**
- 4.5: Domain-Specific State-Space Planning
  - 4.5.1: The Container-Stacking Domain
  - 4.5.2: Planning Algorithm

Chapter 5: Plan-Space Planning

- 5.1: Introduction
- 5.2: The Search Space of Partial Plans
- 5.3: Solution Plans
- 5.4: Algorithms for Plan Space Planning
  - 5.4.1: The PSP Procedure
  - ~~5.4.2: The PoP Procedure~~
- ~~5.5: Extensions~~
- 5.6: Plan Space Versus State Space Planning

No questions on these topics

Chapter 6: Planning-Graph Techniques

- 6.1: Introduction
- 6.2: Planning Graphs
  - 6.2.1: Reachability Trees
  - 6.2.2: Reachability with Planning Graphs
  - 6.2.3: Independent Actions and Layered Plans
  - 6.2.4: Mutual Exclusion Relations
- 6.3: The Graphplan Planner
  - 6.3.1: Expanding the Planning Graph
  - 6.3.2: Searching the Planning Graph
  - 6.3.3: Analysis of Graphplan
- 6.4: Extensions and Improvements of Graphplan
  - 6.4.1: Extending the Language
  - 6.4.2: Improving the Planner
  - 6.4.3: Extending the Independence Relation

use my lecture notes

No questions on these topics

7: Propositional Satisfiability Techniques

- 7.1: Introduction
- 7.2: Planning problems as Satisfiability problems
  - 7.2.1: States as propositional formulas
  - 7.2.2: State transitions as propositional formulas
  - 7.2.3: Planning problems as propositional formulas
- 7.3: Planning by Satisfiability
  - 7.3.1: Davis-Putnam
  - 7.3.2: Stochastic Procedures

No questions on these topics

- ~~7.4: Different Encodings~~
  - ~~7.4.1: Action Representation~~
  - ~~7.4.2: Frame axioms~~

No questions on these topics

Chapter 16: Planning Based on MDPs

- 16.1: Introduction
- 16.2: Planning in Fully Observable Domains
  - 16.2.1: Domains, Plans, and Planning Problems
  - 16.2.2: Planning Algorithms
- 16.3: Planning under Partial Observability
  - 16.3.1: Domains, Plans, and Planning Problems
  - 16.3.2: Planning Algorithms
- 16.4: Reachability and Extended Goals

No questions on these topics

17: Planning based on Model Checking

- 17.1: Introduction
- 17.2: Planning for Reachability Goals
  - 17.2.1: Domains, Plans, and Planning Problems
  - 17.2.2: Planning Algorithms
- 17.3: Planning for Extended Goals
  - 17.3.1: Domains, Plans, and Planning Problems
  - 17.3.2: Planning Algorithms
  - 17.3.3: Beyond Temporal Logics
- 17.4: Planning under Partial Observability
  - 17.4.1: Domains, Plans, and Planning Problems
  - 17.4.2: Planning Algorithms
- 17.5: Planning as Model Checking vs. MDPs

No questions on these topics

The Exam

- Closed book, but you may bring a one page of notes
  - You can write on both sides
- No electronic devices
  - Numeric calculations will be simple enough that you don't need a calculator

Studying for the Exam

- On the password-protected page, I've posted copies of old exams
  - both with and without answers
- Send me email if you've forgotten the name/password

- I sometimes covered the chapters in a different order
  - So not all of the midterm exam is relevant
- All of the final exams are cumulative
  - So some of the material in them may be relevant

- For each exam, look first at the version that has no answers, and try to write your own answers
  - Then look at the version that has answers, and compare those answers to yours

Miscellaneous

- If you have questions about what we've covered, please post them to Piazza rather than sending email
  - You'll get an answer faster
  - Others might like to see the answers